

**National Aeronautics and Space Administration**

**FINAL TECHNICAL REPORT FOR NAG 5-4633**

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**Final Technical Report for NAG 5-4633**  
**Hard X-Ray Emission of X-Ray Bursters**

The scientific goal of this project was to study the hard x-ray emission from x-ray bursters. One target of opportunity observation was made for this investigation during 1997. We obtained 38ks of data on the source 4U1705-44. The project was closely related to “Monitoring x-ray emission from x-ray bursters”, NASA project NAG5-3595, and “Long-Term Hard X-Ray Monitoring of X-Ray Bursters”, NASA project NAG5-3891, and shares publications in common with both of these.

Analysis of the x-ray timing information of that data was completed and appeared in the *Astrophysical Journal* in the paper “Discovery of Kilohertz Quasi-Periodic Oscillations in the Atoll X-Ray Binary 4U1705-44”, by E.C. Ford, M. van der Klis, and P. Kaaret, *Astrophys. J. Letters* 498, L41 (1998). This paper is mainly from the investigation “XTE Kilohertz quasiperiodic oscillations in atoll sources”, NASA grant NAG5-4416, but contains some data taken from this investigation.

To investigate the origin of the hard x-ray emission, we measured the hard lag spectrum of 4U1705-44. This is the time delay between variability in the soft x-ray band (2-9 keV in our case) versus the hard x-ray band (9-33 keV). Our results represent the first detection of hard lags from an accreting neutron star. These results appeared in the paper “Measurement of Hard Lags and Coherences in the X-Ray Flux of Accreting Neutron Stars and Comparison with Accreting Black Holes”, E.C. Ford, M. van der Klis, M. Mendez, J. van Paradijs, and P. Kaaret, *Astrophys. J. Letters* 512, L31 (1999). The results rule out the simplest Comptonization models for the production of hard x-rays and place strong constraints on more complex Comptonization models.